of which this is a continuation appears to have reached a tenth edition.

Section ii. is on the transmission of power. The first example is a screw-driver, and the second a sewer rod coupling. Another example is a cash conveyor, which, as money is power, is no doubt an example of transmission of power. On the next page is a viscosimeter, though what power is transmitted in this case is less obvious. Nor would one naturally expect four examples of acoustic telephones to be found under this heading.

Section vii., on hydraulic power and appliances, commences with some very sketchy ideas for wave motors, and then describes a fog-horn buoy. There is no reasonably good account of any one of the important class of water turbines, but there is a quite impossible design for a "multinozzle turbine," and next to this a duplex steam feed pump. There is a figure of a Venturi meter, but the description does not explain its action, and the curiously inaccurate statement is made that the differential velocity produces a differential pressure in two tubes with mouths turned in "opposite" directions, and ends with the very misleading statement that "the measurement is made by a meter." The reader would not realise that the Venturi tube is the meter, and that what the author probably mistakes for a meter is a recorder.

Section viii., on air power, motors and appliances, contains the "pneumatic ball puzzle," an "aërial top," "grain elevators," "a magic ball," a "megascope," a "sailing wagon," a "tail-less kite," and a "sail-rigged merry-go-round"; but nothing about the air-compressors, air-motors, and pneumatic tools which are now so important.

Enough has been said to indicate the general character of the work. Many useful and important devices are described amongst many others which are mere inventors' schemes. There may be readers who like an olla podrida of this kind.

Perhaps the most curious section, and we think the longest, is that on perpetual motions. About these the author does not seem to have quite made up his own mind. He does warn the reader in the preface that the problem is "unsolvable." But later, p. 363, he remarks that "attempts to solve this problem would seem, so far, only to have proved it to be thoroughly paradoxical," a statement which would hardly get many marks in a science examination. Further, we are told on the next page that, although admitting difficulties in the way of its discovery, "many eminent mathematicians have favoured the belief in the possibility of perpetual motion"; also that "it is evident, therefore, that even mathematicians are not agreed."

Modern Theory of Physical Phenomena, Radioactivity, Ions, Electrons. By Augusto Righi. Authorised translation by A. Trowbridge. Pp. xiii + 165. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1904.) Price 5*s.* net.

IT is an interesting sign of the times that so many books have appeared during the last few months with the object of explaining in non-technical words the recent development of physical science. Part of the interest shown in these subjects by the general reading public is, no doubt, of the unintelligent and wonder-seeking order, which classes the more striking discoveries of natural science with the latest sensation of the law courts, or the cost of the flowers at a Transatlantic ball. But it is fair to hope that some, at all events, of those who read of the advance of knowledge do so with a desire to comprehend the method, as well as to admire the results, of scientific research. A more widely spread application of the open-minded and truth-seeking methods of science to the problems of individual and collective life is, for the sake of the community, greatly to be desired.

The little book before us deals in a light and interesting manner with the conceptions of the physical world which have been used of late in investigating the phenomena of light, electricity, and radio-activity. It states the results of recent inquiries in a clear and intelligible manner, and, if the account of the methods used in reaching the results sometimes seems inadequate, the difficulty of explaining those methods to non-scientific readers may be urged as an excuse.

After an introduction, the book contains chapters on electrolytic ions and electrons; electrons and the phenomena of light; the nature of the kathode rays; the ions in gases and solids; radio-activity; mass, velocity, and electric charge of the ions and of the electrons; and the electrons and the constitution of matter. The volume ends with a useful bibliography of the subjects considered.

The translation, on the whole, is well done, though a certain want of crispness in the literary style is felt in places.

In a future edition one or two corrections would be advisable. The period of vibration of light cannot be "expressed by a fraction whose numerator is unity and whose denominator is a number of fifteen places" unless it is understood that "a fraction" is a fraction of a second. The usual figure given to illustrate the opposite deflection by a magnetic field of the α and β rays from radium exaggerates greatly the deflection of the α rays compared with that of the β rays. This exaggeration is legitimate, in fact, necessary, in a diagrammatic representation; but it should be pointed out in the text, or misconception of the relative magnitudes of the two effects is sure to follow. In Thomson's method of determining the properties of the ions produced by the incidence of ultra-violet light on a metallic surface, the exactness is limited not only by the differing velocities of the ions, as stated in the book. Probably the ions are produced, not solely at the metallic surface, but also in a layer of the gas of finite thickness in its neighbourhood. Thus the distance from the surface reached against the influence of a magnetic field may be different for different ions even if their velocities be the same.

The Journal of the Royal Agricultural Society. Vol. lxv. Pp. clxvi + 392. (London: Murray, 1904.)

THE *Journal* of the Royal Agricultural Society makes its appearance this year in a rather slimmer form than usual, due, however, more to the use of a thinner paper than to a curtailment of the printed matter. The affairs of the society bulk largely as usual, taking up more than half the present volume, while the miscellaneous articles, to which the ordinary reader turns, only occupy about 150 pages. The volume is, in fact, burdened far too much with reports of council meetings and committees, which have lost all interest for the members by the time the annual volume reaches them, and which would be much more to the point if circulated as "proceedings" immediately after the meetings and not reprinted here.

The volume opens with a vivacious and readable account of Sir Humphry Davy by Mr. H. B. Wheatley, who well brings out the charm and fascination of Davy's personality. But we cannot help thinking Mr. Wheatley rates Davy's agricultural work altogether too highly; if any man is to be called "father of the science" it is De Saussure, and not Davy, who can be identified with no new discovery or novel point of view in agricultural science. In this respect Davy was somewhat like Liebig; both were great men who had the power of getting the world to listen to them, and when they turned their attention to agriculture the influence they wielded, each in their

generation, and the stimulus they gave to the progress of agriculture were out of all proportion to the value of the knowledge or even of the ideas they contributed to the subject. Davy gave dignity to the study of agricultural science; where Davy had laboured no man in future need be ashamed to work. Two articles follow on fruit farming, by Mr. Charles Whitehead, and on vegetable farming, by Mr. James Udale. Both are sound enough, but they are rather jejune performances for the *Journal* of the Royal Agricultural Society, since from the inevitable limitations of space they are too lacking in detail to be of service to anyone but the amateur. When it comes to reproducing pictures of the wireworm from the Society's text-book of agriculture, instructions for making Bordeaux mixture, and similar elementary matters, the farmer reader may well wonder where the editor's blue pencil has been lying. Mr. Dudley Clarke writes on a burning question of the day, the cost of labourers' cottages, and gives a number of sensible plans, bringing out the cost of a brick and tile cottage with three bedrooms at about 150*l.*, including the land and the cost of a well.

Mr. A. D. Hall writes on the agricultural experiments of Mr. James Mason, the well-known founder of the firm of Mason and Barry, who spent his later leisure in attempting to apply science to agriculture with some success, while the rest of the volume is occupied with the last Park Royal show, with reports of the experiments in progress at the Woburn Farm, and with other society matters.

Mediaeval Lore from Bartholomew Anglicus. By Robert Steele; with preface by William Morris. Pp. xv+195. (London: Alexander Moring, Ltd., 1905.) Price 1*s.* 6*d.* net.

THIS beautiful addition to the "King's Classics," of which Prof. Gollancz is the general editor, is likely to prove of interest to students of science. Written by an English Franciscan, probably before 1260, to explain the allusions to natural objects met with in the Scriptures and elsewhere, it is really an account of the properties of things in general so far as they were understood by an educated writer of the Middle Ages. After studying the quaint and pleasant accounts of mediæval science, medicine, geography, and natural history which the book contains, the student will begin to realise that during the Middle Ages science was not stagnant, but, by gradual development, was making possible the rapid growth of scientific knowledge characteristic of the nineteenth century. The reprint deserves to be read widely.

Ergebnisse und Probleme der Zeugungs- und Vererbungs-lehre. By Prof. Oscar Hertwig. Pp. 31. (Jena: G. Fischer, 1905.) Price 1 mark.

PROF. OSCAR HERTWIG is well known as a pioneer in the researches on fertilisation. In 1875 he made the important discovery that the essential fact in the process lay in the fusion of a single male with a female cell, and he also saw and recognised the fusion of the nuclei. It was fitting that at the congress held at St. Louis last year he should choose this subject as the text of his lecture. The reprint forms a clear statement of the chief details of fertilisation, and also indicates some of the theoretical conclusions towards which modern cytology is tending. The sketch of the so-called "reduction divisions" is specially good, and the author shows how clear a light they throw on the modern experimental results obtained from the study of heredity. The lecture will be welcomed by all who are interested in these and kindred questions, and those who know Prof. Hertwig's writings will not be surprised to find that if the treatment is of necessity brief, it is masterly of its kind.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Dynamical Theory of Gases.

IN Mr. Jean's valuable work upon this subject he attacks the celebrated difficulty of reconciling the "law of equipartition of energy" with what is known respecting the specific heats of gases. Considering a gas the molecules of which radiate into empty space, he shows that in an approximately steady state the energy of vibrational modes may bear a negligible ratio to that of translational and rotational modes.

I have myself speculated in this direction; but it seems that the difficulty revives when we consider a gas, not radiating into empty space, but bounded by a perfectly reflecting enclosure. There is then nothing of the nature of dissipation; and, indeed, the only effect of the appeal to the æther is to bring in an infinitude of new modes of vibration, each of which, according to the law, should have its full share of the total energy. I cannot give the reference, but I believe that this view of the matter was somewhere expressed, or hinted, by Maxwell.

We know that the energy of ætherial vibrations, corresponding to a given volume and temperature, is not infinite or even proportional to the temperature. For some reason the higher modes fail to assert themselves.[1] A full comprehension here would probably carry with it a solution of the specific heat difficulty. RAYLEIGH.

The Physical Cause of the Earth's Rigidity.

SINCE publishing the paper in the *Astronomische Nachrichten* (No. 3992), the investigations there outlined have been considerably extended, and lead to some remarkable results. My only purpose in this letter is to direct attention more particularly to the physical cause of the earth's rigidity. This seems to have remained rather obscure, and I am not aware that any definite theory has been adopted to account for the remarkable fact established by the researches of Lord Kelvin and Prof. G. H. Darwin.

It was pointed out in the *Astronomische Nachrichten* (3992) that the physical cause of the earth's high effective rigidity is to be found in the great pressure existing throughout the interior of our globe. This may be made somewhat more obvious by remembering that in any concentric spherical surface the resistance of the enclosed nucleus must be just equal to the pressure of the surrounding shells resting upon it, and thus the strain upon the matter of the globe increases towards the centre according to the same law as the curve of pressure given in the *Astronomische Nachrichten* (3992). This pressure is sustained by the increasing density and rising temperature of the matter in the earth's interior, which is thus under an inconceivable strain, far surpassing the strength of any known substance. As the matter is above the critical temperature of every element, it is essentially a gas reduced by pressure to a hardness greater than that of steel, and with an elasticity and rigidity infinitely near to perfection. The result is that the explosive strain upon the matter of our globe from within, which is everywhere just equal to the pressure sustained by the enclosed nucleus, renders the interior matter more rigid than any known substance; and even the outer layers, which are but slightly compressed, yield so little under the action of external forces that the globe as a whole is more rigid than steel, as Lord Kelvin and Prof. G. H. Darwin found from their profound researches on the long-period tides of the ocean.

It was these considerations which led to the conclusion that all the heavenly bodies of considerable mass when condensed to moderate bulk have nuclei of great effective rigidity, and experience no sensible circulation at great depths. T. J. J. SEE.

U.S. Naval Observatory, Mare Island, Cal., March 20.

[1] Compare "Remarks upon the Law of Complete Radiation" (*Phil Mag.*, xlix. p. 539, 1900).